

# BMD Technology Program Overview



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DTIC QUALITY INSPECTED 4



## TECHNOLOGY PROGRAM GOALS

*Threats And Technology Do Not Stand Still, Therefore*

- Support Missile Defense With Component Technology Improvement

*Increase And*

- Range
- Lethality
- Accuracy
- Effectiveness
- Productibility

*Decrease*

- Size
- Cost
- Weight

*Pursue Advanced Concepts For Future Responses To An Evolving Threat*

- New Kill Mechanisms
- High Payoff (Boost-phase Intercept)

**The Key To Improved Performance And Cost Reduction Is Technology Innovation**



# TOWARDS A BALANCED TECHNOLOGY PROGRAM

## Balanced Technology Investments (6.2, 6.3)



### Near-term Technology Infusion

- Cost Reduction
- Risk Reduction
- Shorten Development Timelines

### Advanced Technologies (Preplanned Product Improvement; New Systems)

- Countering Advanced Threat
- Reduce Cost / Risk
- Increase Effectiveness
- Support Special Missions

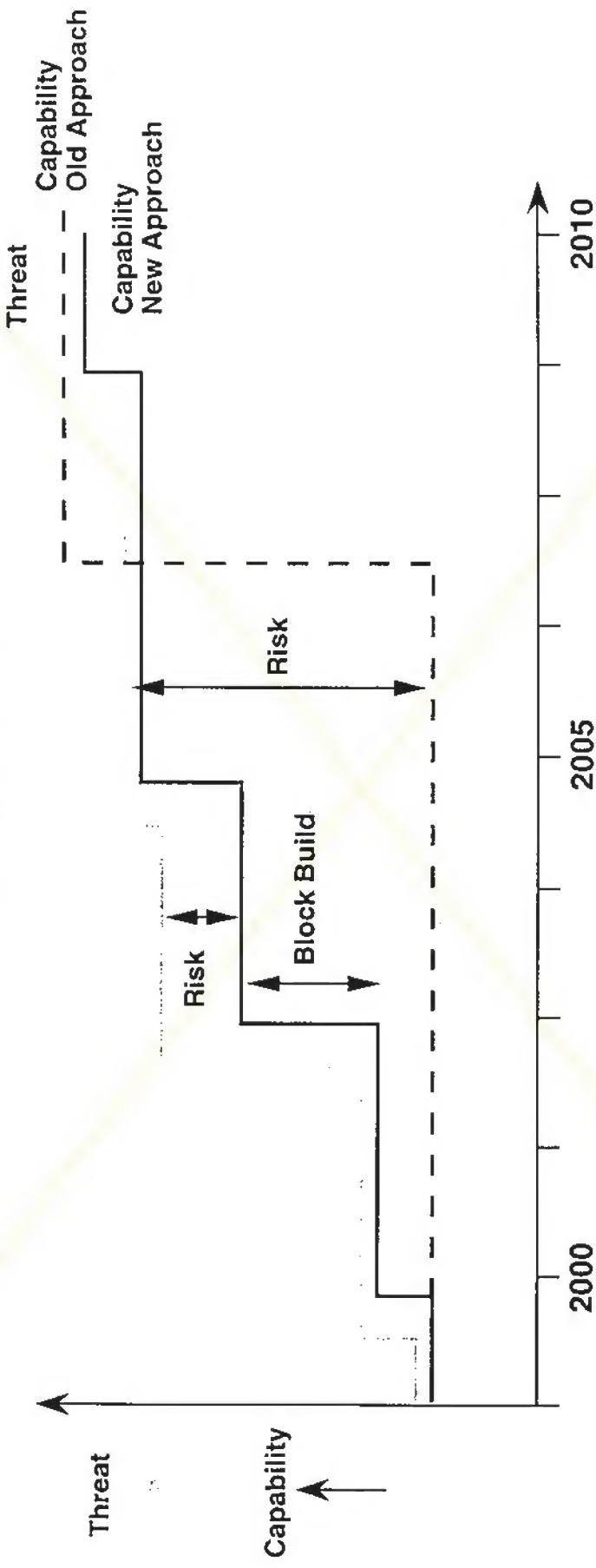
### Innovative Science And Technology

- Revolutionary Technologies / Processes
- Future Architecture / Operational Concepts



# OPPORTUNITY – MATCHING ARCHITECTURE TO THE THREAT

*National Threat*



- Use Continuous Building Block Approach
- Deliver Warfighting Capability Now To Meet Today's Threat
- Lay Out Continuous Implementation / Technology / Funding Road Map To Meet Tomorrow's Threat



# FACILITATING COST SAVINGS ACROSS THE JOINT MISSION AREA

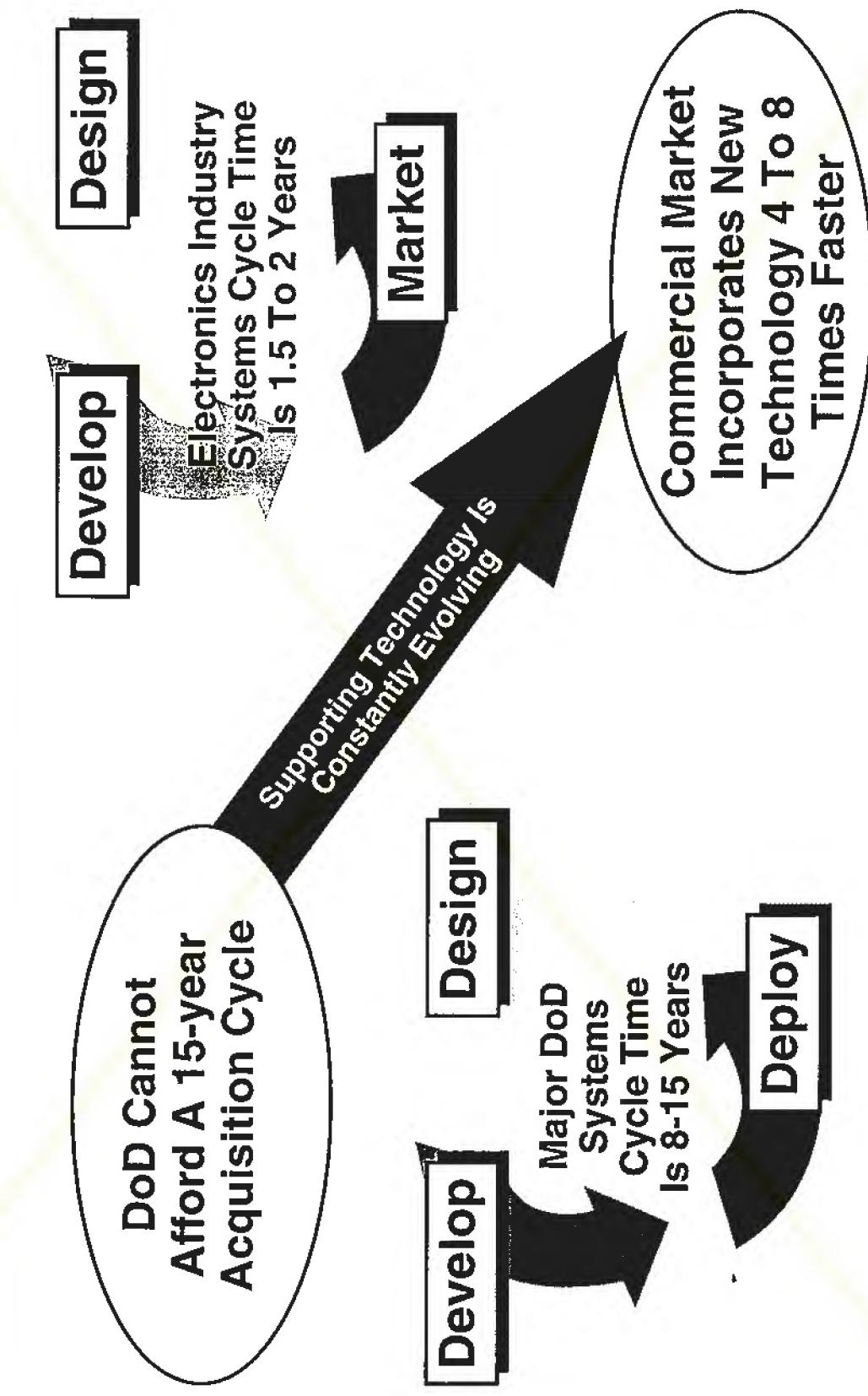
## *Challenges*

- Redundant Capabilities
- Proprietary Technologies

## *Opportunities*

- Define And Implement Open Systems Approach To Hardware Development
  - Plug And Play Modules For Future Architecture / Systems To Lower Cost, Facilitate Interoperability, Reduce Proprietary Solutions
- Rethink The Management Of Risk Reduction Technology Development Programs
  - Focus On Joint Solutions
  - Architecture And System-level As Opposed To Service / Platform Specific

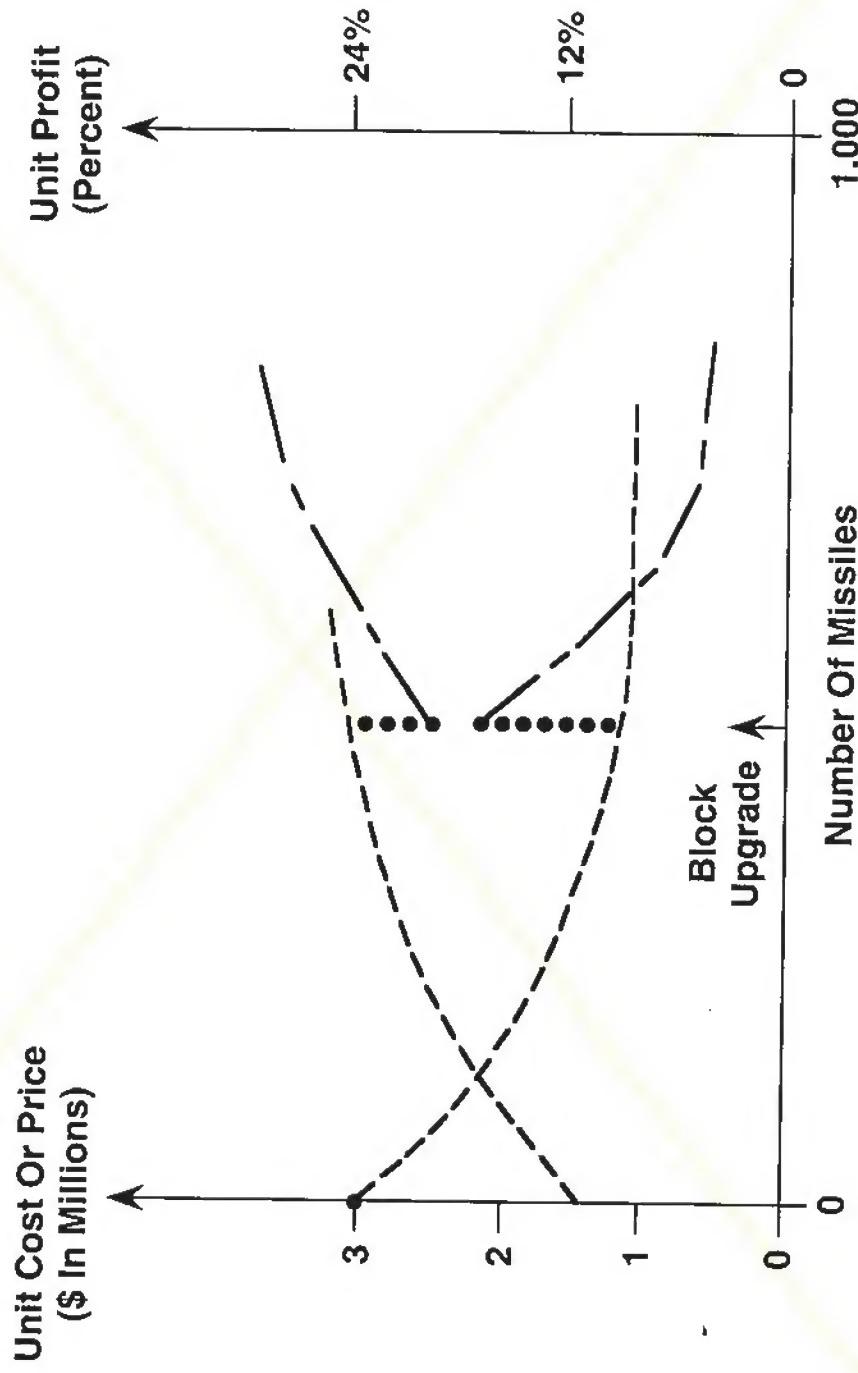
## NEAR-TERM TECHNOLOGY INFUSION





## NEW APPROACH

### *Lean Missile Initiative*





# PROPOSED NEAR-TERM TECHNOLOGY INFUSION PROGRAMS

<b>Materials And Structures (Cooperation With Affordable Multi-Missile Manufacturing Program (AM3))</b>	<ul style="list-style-type: none"> <li>• <i>Polymer Matrix Composites*</i></li> <li>• Metal Matrix Composites</li> <li>• Advanced Ceramics For Manufacture Of Radomes / Shrouds</li> <li>• IR Windows</li> </ul>
<b>Propulsion</b>	<ul style="list-style-type: none"> <li>• <i>Component Development / Manufacture For DACS**</i></li> <li>• Energetic Propellants For TMD / NMD Sustainer Engines / DACS</li> </ul>
<b>Sensors (Cooperation With AM3)</b>	<ul style="list-style-type: none"> <li>• <i>Family Of Interferometric Gyro-based INS Systems For Interceptors*</i></li> <li>• Transmit / Receive Module Cost Reduction</li> <li>• Solid-state Transmitter For PAC-3 / MEADS**</li> <li>• Focal Plane Array Productibility</li> <li>• Master Frequency Generator*</li> </ul>
<b>Signal Processing Electronics (Cooperation With AM3)</b>	<ul style="list-style-type: none"> <li>• COTS-based Radar Architectures</li> <li>• <i>Advanced Signal Processing For Seekers / Radars / Electro-Optics**</i></li> </ul>
<b>BM/C<sup>3</sup> Hardware</b>	<ul style="list-style-type: none"> <li>• Large, Ruggedized Displays For BM/C<sup>3</sup> Centers</li> <li>• Asynchronous Transfer Mode Communications</li> <li>• Microwave Power Modules</li> </ul>
<b>Batteries</b>	<ul style="list-style-type: none"> <li>• Advanced Thermal / Lithium Batteries</li> </ul>

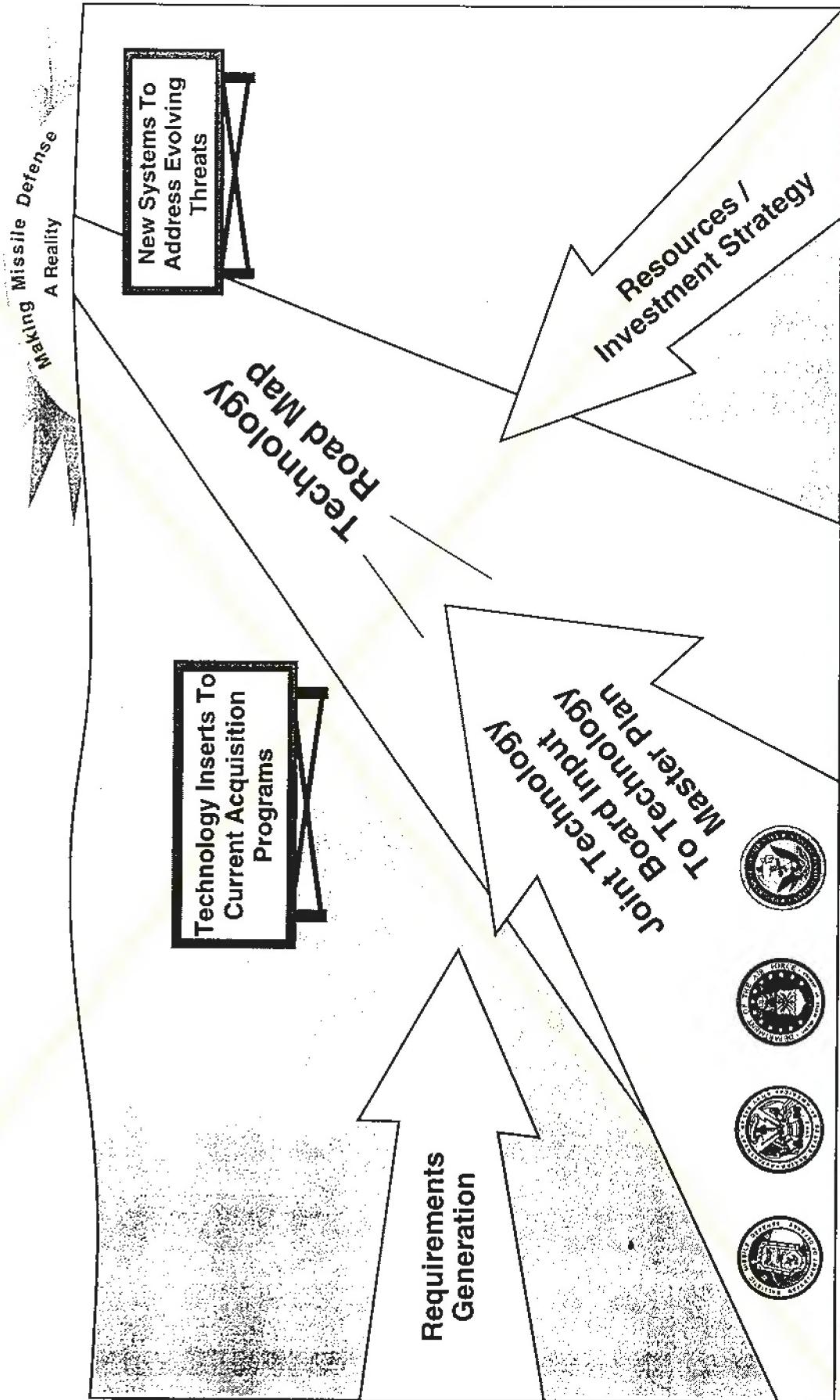
\* Ongoing Project

\*\* Proposed 1999 Project

m-90877 / 040899



# TECHNOLOGY PROGRAM PLANNING





## TECHNOLOGY MASTER PLAN OBJECTIVES

- Greater Understanding Of The Evolving Threat And Mission Essential / Enabling Capabilities
- Develop Technologies That Keep Pace With The Threat, Reduce MDAP Costs, And Mitigate Risk
- Identify Timelines For Technology Development
- Align Existing Technology Programs, Leverage Service Technology Programs, And Develop New Technology Programs To Meet FoS And NMD Needs
- Determine Level And Timing Of Required Financial Resources

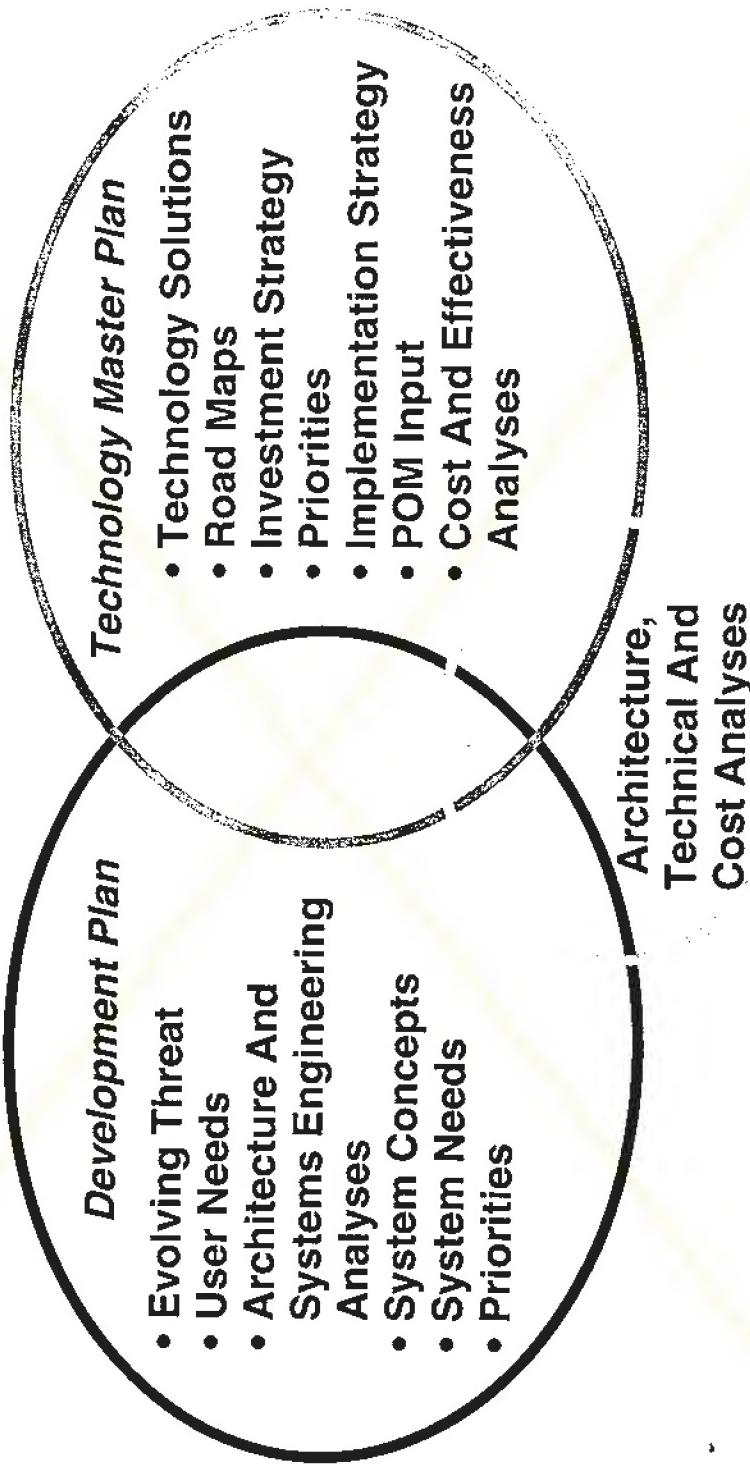
It Is Not Uncommon For People To Equate R&D With The Development Of Hardware, A View Which Is As Limited As It Is Erroneous. The Product Of The R&D Effort Is An Operational Capability. Weapons Hardware Is But One Subsystem Of Operational Capability. This Point Must Be Reemphasized; The Objective Of R&D Is Operational Capability, Not Hardware Per se.

DON RDT&E / Acquisition Management Guide



# BMDO PLANNING FOR TECHNOLOGY INVESTMENT

*The Development Planning Process Provides BMDO's System Needs For Technology And Basis For Investment*



**The Technology Master Plan Defines BMDO's Investment And Approach To Obtaining The "Needed" Technology**



# ANNUAL TMP PROCESS

DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
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PPBS  
POM Preparation

POM  
PB

BES Preparation

- Director's Guidance  
 • Threat Updates - DCI  
 • MDAP Status - AQ / JN  
 • Resource Constraints - PO

JTB And  
SAEB Review

PMA Plan  
Guidance

Draft  
Devel  
Plan

Future System Capability Architecture, Needs Analysis And Risk Assessment (Ongoing)

Coordinate  
User Inputs

- Threat Description
- Mission Needs Update
- Architecture Updates
- System Needs Revisions

TMP  
Ch. 2-4

Development  
Plan

Development  
Plan Update

Investment And  
Implementation  
Strategies - Ch. 6

Updated  
Technology  
Master Plan

Selected TPT Reviews

Technology Area Plans - Ch. 5

Program Descriptions Update

A

B



## CHALLENGE: INVOLVING THE CONTRACTOR COMMUNITY

- Government-Industry Open System Applications Group
  - Strategic Partnership With DARPA Affordable Multiple Missile Manufacturing (AM3) Program
  - Initial Meeting Held 18 MAR 98
- Establish Best Practices And Standards For
  - Key Hardware Components
    - Examples: Guidance And Control, T / R Modules, Propulsion, Materials And Structures, Signal Processing Electronics, etc.
  - Grow To Include Key Software Applications (Treat As Components)
    - Examples: BM/C<sup>3</sup>, Hit-To-Kill Guidance, Discrimination, etc.
  - Extend To Include Key Infrastructure Elements
    - Examples: M&S, Testing, Data Analysis And Handling, etc.



## INDUSTRY REVIEWS

- TMP Coordinator Will Schedule Industry Meetings Through The GOSAG
  - BMDO Programs Will Be Presented To Industry
  - Two-way Exchange Of Information On Programs, IRAD, And Technology Needs With Each Individually
  - TPT Cochairs And Industry Representatives Will Attend



## TECHNOLOGY PLANNING TEAMS (TPT)

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- TPT Areas
  - Interceptors
  - Surveillance
  - BM/C<sup>4</sup>I\*
  - Directed Energy\*
- Responsibilities
  - Identify Programs That Meet Technology Needs
  - Develop Technology Area Plans
  - Tailor Or Leverage Existing Programs Where Possible, Otherwise Recommend New Starts
  - Produce Technology Road Maps
  - Prioritize Technology Programs

\* Formed 1998



# TECHNOLOGY PROGRAM APPROACH

Threat	Stressed BMD Function	System Need For Technology	Technology Focus
<ul style="list-style-type: none"> <li>• Pennoids           <ul style="list-style-type: none"> <li>- Jammers</li> <li>- Flares</li> <li>- LREPs</li> <li>- Aerosols</li> <li>- Coatings</li> <li>- Chaff</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Discrimination</li> <li>• Kill Assessment</li> <li>• Track And Track Accuracy</li> </ul>	<ul style="list-style-type: none"> <li>• RF / IR Discrimination</li> <li>• Signature Characterization</li> <li>• Multiple Sensor Data Fusion</li> <li>• TDM Generation</li> <li>• High Performance Data / Signal Processing</li> </ul>	<ul style="list-style-type: none"> <li>• Integrated Active / Passive Seeker</li> <li>• Multicolor Seeker (IR)</li> <li>• Laser Radar / Interrogator / Imaging Radar</li> <li>• Discrimination / Sensor Fusing Algorithms</li> <li>• Wave Front Sensing</li> <li>• Wideband Radar Processing</li> <li>• High-power / Efficiency T/R Modules</li> <li>• High-G Divert</li> <li>• BM Logic For Object Sampling</li> </ul>
<ul style="list-style-type: none"> <li>• Advanced Submunitions</li> </ul>	<ul style="list-style-type: none"> <li>• Intercept Timeline</li> </ul>	<ul style="list-style-type: none"> <li>• Surveillance</li> <li>• Boost Phase Intercept</li> <li>• Kinetic Energy           <ul style="list-style-type: none"> <li>- Directed Energy</li> <li>- Multiple Sensor Data Fusion</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Cooled Window</li> <li>• Wide Field Of Regard Seeker</li> <li>• Plume / Hard Body Aim Point</li> <li>• Blended Aero / Divert</li> <li>• Typing</li> <li>• Detection / Background Suppression Algorithms</li> <li>• Wave Front Sensing</li> <li>• Multispectral Sensor Fusion</li> <li>• High-power / Efficiency T/R Modules</li> </ul>
<ul style="list-style-type: none"> <li>• Way Point Navigation</li> <li>• Multi-axis Attacks</li> <li>• Very High-G Maneuver</li> <li>• Reduced RCS (VLO)</li> <li>• Very Low Altitude</li> </ul>	<ul style="list-style-type: none"> <li>• Lethality</li> <li>• Maneuverability</li> <li>• Minimum Intercept Altitude</li> <li>• Surveillance</li> <li>• Battle Management</li> <li>• Affordability</li> </ul>	<ul style="list-style-type: none"> <li>• Safe High Performance DACS</li> <li>• Traffic Handling</li> <li>• Lower Tier Discrimination</li> <li>• Processing And Algorithms</li> <li>• Reduced Life Cycle Cost</li> </ul>	<ul style="list-style-type: none"> <li>• High-G Fast Response Divert</li> <li>• Maneuvering Target Algorithms</li> <li>• Wide Field Of Regard Seeker</li> <li>• Fast Frame FPA / On FPA Motion Detector</li> <li>• RF / IR Apertures</li> <li>• Blended Aero / Divert Control</li> <li>• Real-time Data Processing / Fusion</li> <li>• High-power / Efficiency T/R Modules</li> <li>• VLWIR Multiple Quantum Well FPA</li> <li>• Waveform Sensing</li> </ul>



## INTERCEPT FOCUS AREAS

- Atmospheric Interceptor Technology (AIT)
  - Advanced Lower Tier Intercept Technology
  - Endoatmospheric Seekers, Windows, Interceptor Agility, Safe DACS, Optimal Guidance, Estimation Of Target Maneuvers
- Exoatmospheric Interceptor Technology (EIT)
  - Advanced Technologies For NMD And TMD Upper Tier
  - Multicolor Focal Plane Arrays, Laser Radar, Advanced Processors, Algorithms
- Boost Phase Intercept (BPI)
  - Target State Estimation Sensors And Algorithms, Missile Plume To Hard Body Handover

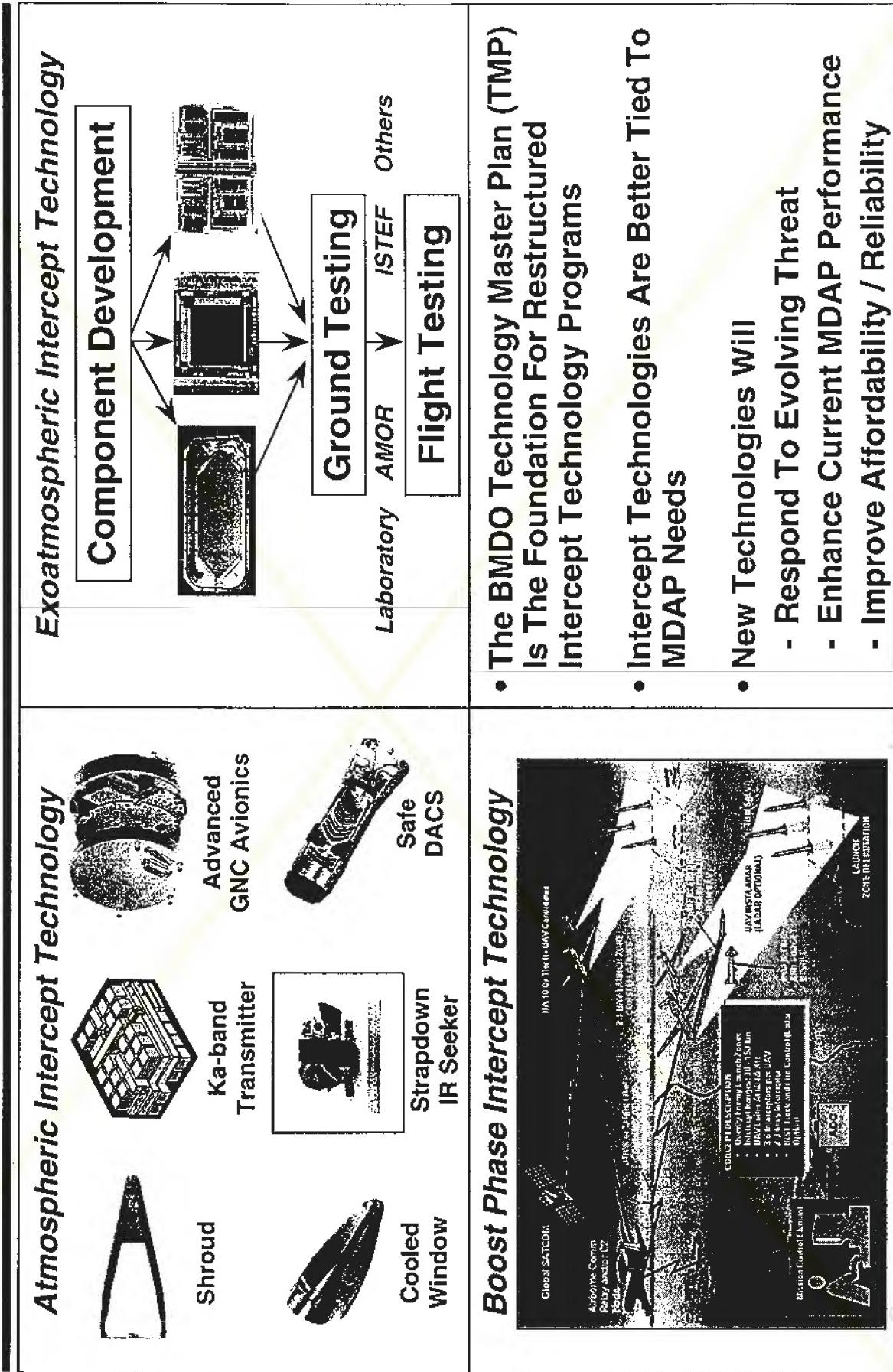


## TMP TECHNOLOGY AREAS

- Atmospheric Interceptor Technology (AIT)
- Exoatmospheric Interceptor Technology (EIT)
- Boost Phase Intercept Technology (BIT)
- Advanced Radar Technology (ART)
- Advanced Passive Technology (APT)
- Advanced Mission Technology (AMT)
- BM/C<sup>4</sup>I Advanced Technology (BAT)
- Directed Energy Technology (DET)



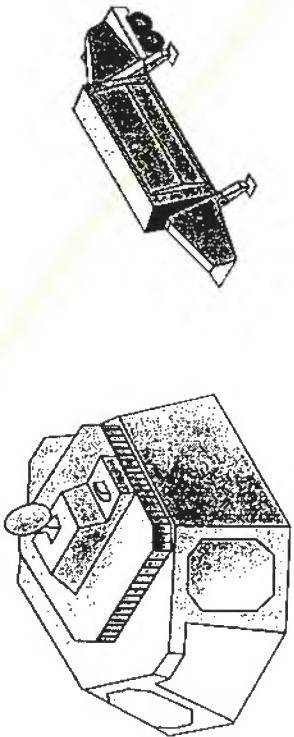
# INTERCEPT INTEGRATED TECHNOLOGY PROGRAMS



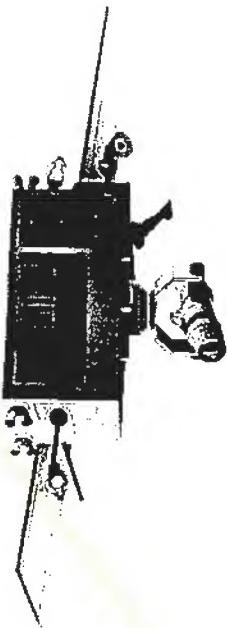


## SURVEILLANCE INTEGRATED TECHNOLOGY PROGRAMS

### *Advanced Radar Technology (ART)*



### *Advanced Passive Technology (APT)*



### *Advanced Mission Technology (AMT)*



- The BMDO Technology Master Plan (TMP) Is The Foundation For Surveillance Technology Programs

- Surveillance Technologies Are Directly Tied To MDAP Needs

- Technology Efforts Will
  - Meet Current MDAP Requirements
  - Respond To Evolving Threat
  - Improve Affordability / Reliability

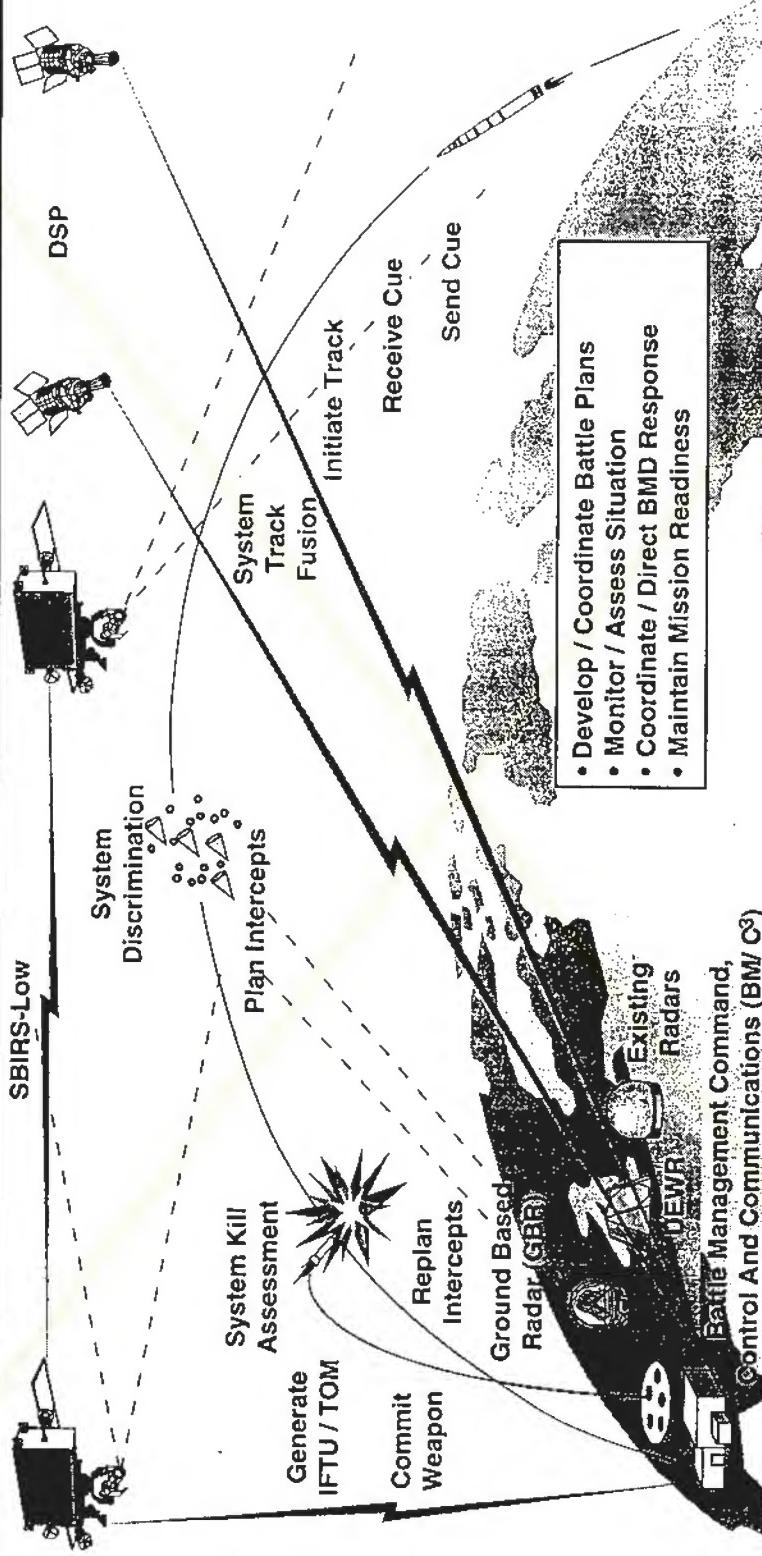


## SURVEILLANCE FOCUS AREAS

- Advanced Radar Technology (ART)
  - Increased Power Aperture And Beam Agility, Enhanced Waveform Design
  - Low Cost T / R Modules, Improved Processors, Advanced Algorithms
- Advanced Passive Technology (APT)
  - Advanced Components For Satellite Surveillance, Acquisition, Track, Discrimination, Kill Assessment (SATDKA)
  - Improved FPA Uniformity, Longer Wavelengths, Optics Cleaning, Cryocoolers, Radiation Hardened Electronics
- Advanced Mission Technology (AMT)
  - SATDKA Functions For Cruise Missile Threat



# BM/C<sup>4</sup>I ADVANCED TECHNOLOGY (BAT)



## Defense Against Strategic Ballistic Missiles

- The BMDO Technology Master Plan (TMP) Is The Foundation For Restructured BM/C<sup>4</sup>I Technology Programs
- BM/C<sup>4</sup>I Technologies Are Tied To MDAP Needs
  - New Technologies Will
    - Improve Battle Management In Response To An Evolving NMD / TAMD Threat
    - Enhance Current MDAP Performance And Improve Affordability / Reliability
  - Address Advanced Mission Threat Battle Management



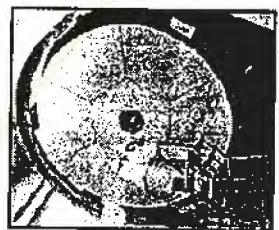
## BM/C<sup>4</sup>I FOCUS

- BM/C<sup>4</sup>I Advanced Technology (BAT)
  - Use Open Systems Standards, Leverage Communications Infrastructure
  - Battle Management Technology, Situation Awareness, Kill Assessment, Evaluation Tools

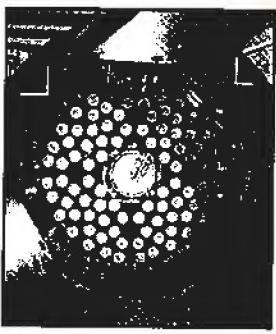


# DIRECTED ENERGY TECHNOLOGY DEVELOPMENT CONCEPT

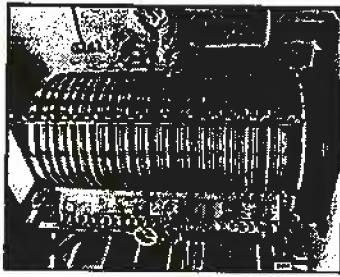
## Demonstrated Technologies



Large Optics  
(LAMP, 1989)



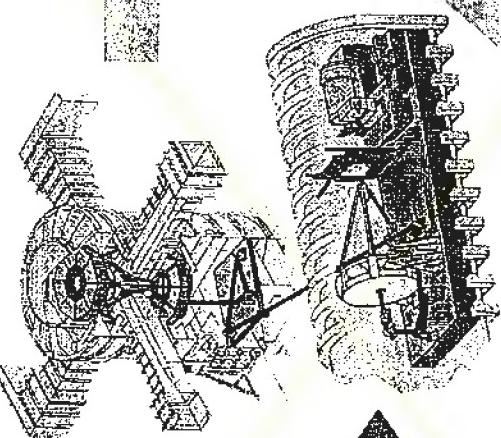
Beam Control  
(LODE, 1987)



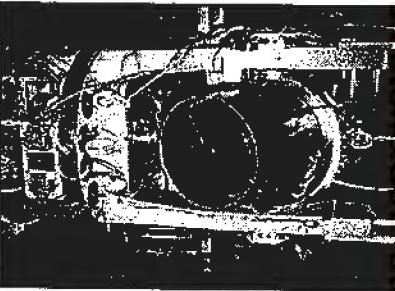
Laser  
(Alpha, 1991)

## Integration

Alpha LAMP Integration (ALI)  
End-to-end Weapon Element Testing

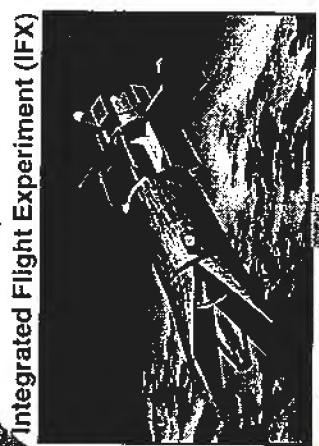
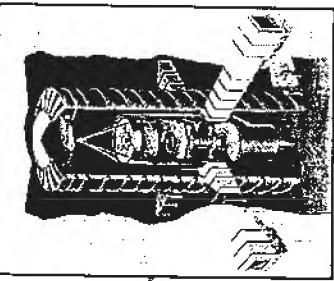


*Acquisition, Tracking, Pointing  
And Fire Control*  
(High Altitude Balloon Experiment (HABE))

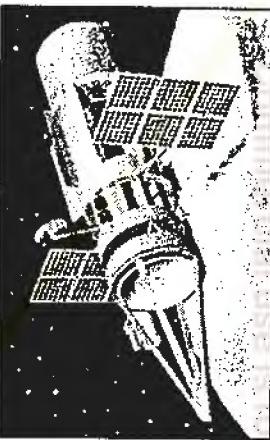


## System-level Development

Integrated Ground Demonstrator (IGD)



Future Operational SBL





## DIRECTED ENERGY FOCUS

- Directed Energy Technology (DET)
  - Integrated Technology For Space Based Laser Integrated Flight Experiment (IFX)
  - Precision Pointing, Waveform Sensing Adaptive Optics, Advanced Beam Generation



## RESEARCH / EXPLORATORY DEVELOPMENT (IS&T, SBIR)

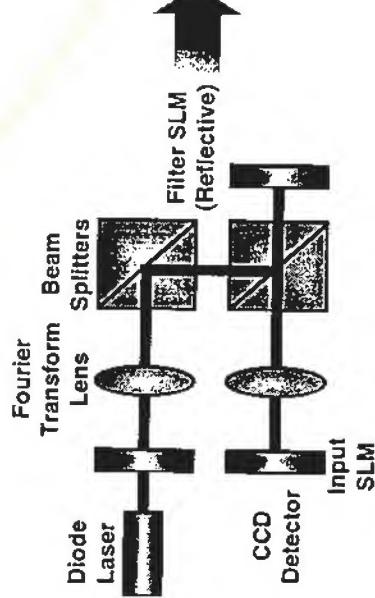
- Innovative Science And Technology (IS&T)
  - Research And Exploratory Development Targeting Breakthrough Technologies For Ballistic Missile Defense
  - Core R&D Program In Sensing, Directed / Kinetic Energy, Materials, Propulsion, Power, And Information Processing
- Small Business Innovative Research (SBIR)
  - Mandated Percentage Of Extramural R&D

# INNOVATIVE RESEARCH - HIGH RISK TECHNOLOGY FOR BMDO'S FUTURE



## Development Of Grayscale Optical Correlator

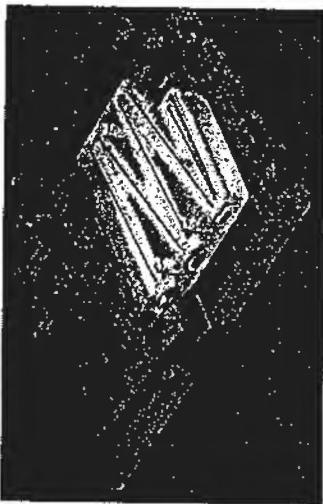
### Optical Correlator Schematic



BMDO Funded Camcorder-sized  
Grayscale Optical Correlator  
JPL – 1998



Matchbox-sized Optical  
Correlator To Be Delivered For  
DoD And NASA Applications



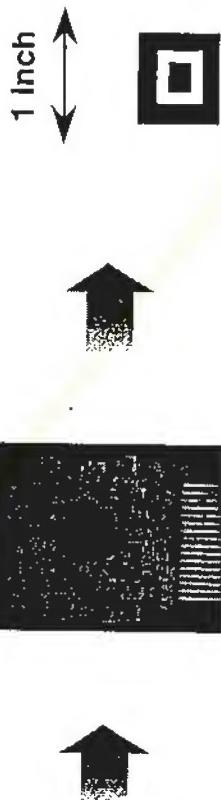
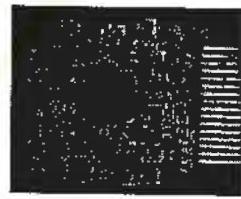
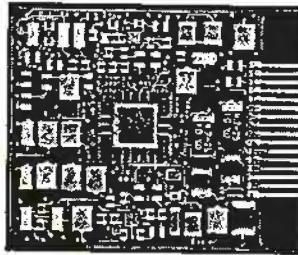
## 1998 INS / GPS



6-dof ISA  
3 cu in

1997  
0.47 cu in  
Commercial Gyro

## MEMS Gyro Instrument Progression



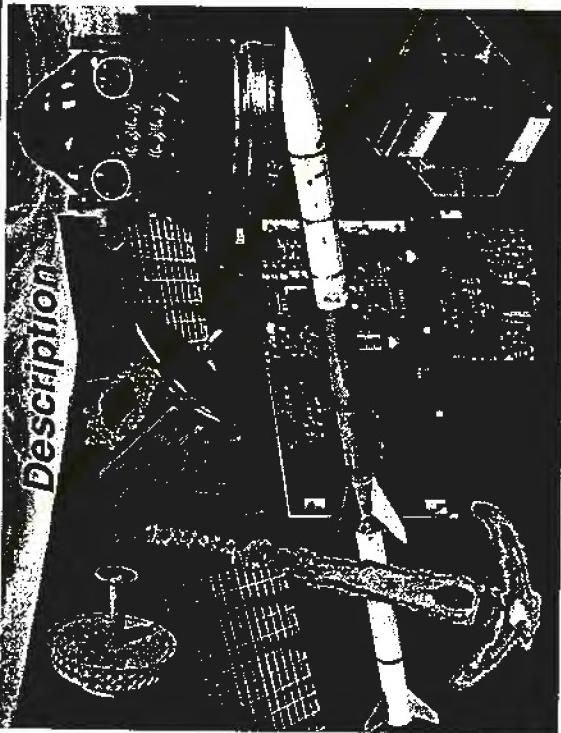
1998  
0.35 cu in  
High Performance Gyro

1999  
0.17 cu in  
High Performance Gyro



# INNOVATIVE SCIENCE AND TECHNOLOGY

## Description



## Issues

- Rapid, Drastic Funding Reductions Are Devastating To Innovative Research And Will Limit BMDO's Ability To Meet Advanced Threats
- Current Program Supports Several Key Technologies And Closes Out Many Others, No Significant New Starts
- Funding Reductions In Opposition With Recent Congressional Language

## Benefits / Applications

- Keeps BMDO On "Cutting Edge" Of Technology, BMDO's Investment In The Future
- Identifies And Develops Key New Technologies To Meet Emerging And Far-term Threats
- Provides Innovative Upgrades For Existing Systems
- MDAP Relevance: Generic High Payoff Technologies For TMD/NMD/CMD Applications

## Budget / Selected Products

FY 00 PB (FY \$M)					
FY 95	FY 96	FY 97	FY 98	FY 99	FY 00
\$80.00	\$65.00	\$52.00	\$52.82	\$22.98	\$7.86

- SCARLET Arrays And Hall Thrusters For SBIRS-class Programs
- Advanced Thermal Batteries For THAAD
- Lasercom For Rapid, Secure Communications
- Miniature Interceptor Technology For Advanced Submunitions
- Advanced Sensors / Sugar Cube Processor / Neural Net Algorithms For BMD / CMD ATR

## IMPLEMENTATION STRATEGY



- Based On Director's Guidance To Allocate 10% (Minimum) – 12% (Goal) Of BMDO Total Obligational Authority To Technology Development
  - Includes Set-asides (e.g., SBL Readiness Demonstrator, SBIR)
- Consistent With Technology Priorities
  - Solution Or Mitigation Of A Critical Challenge
    - Cost Reduction
  - Multiple Potential Applications
  - Breakthrough Technologies



## A NEW APPROACH

- Building Consensus Requires New Approach
  - Relate Technology Programs To Military Deficiencies, Technology Needs And Operational Capability
  - Establish Process For Corporate Participation And Decision Making
  - Develop A Product To Guide And Coordinate Missile Defense Technology Programs
- The Technology Master Plan Process Incorporates This Paradigm Shift



## SUMMARY

- BMDO TMP Is The Vehicle For Implementing Director's Guidance For Technology
  - Maintain U.S. Technical Superiority In Missile Defense
  - Relate BMDO Technology To MDAP Needs And Operational Capabilities
  - Allocate A Goal Of 12% Of TOA, But Not Less Than 10% For BMDO Technology Program
  - Maximize Participation Of Missile Defense Community In BMDO Technology Program